

Paleoceanographic changes of the Japan Sea during the last 12 m.y. based on the radiolarian analysis

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Radiolarians live in a depth range from the surface to the great depths in the modern ocean, so they have much potential to reconstruct past vertical water structure as well as surface layer environments. To reconstruct paleoceanographic changes in the Japan Sea during the last 12 m.y., we analyzed radiolarian assemblages in a deep-sea sedimentary sequence from the central part of the sea. Our results revealed that the surface layer changed from a warm condition in the late Miocene to a cooler one in the late Pliocene with some fluctuations and cooling steps that occurred at 6.5, 3.5 and 2.5 Ma. Warm water inflows from the south do not seem to have existed before the mid-Pliocene time. The signal of such inflow that can be comparable to the today's Tsushima Current first appeared at 2.2 Ma. Occurrence of the deep as well as intermediate water species indicates the presence of deep and intermediate water masses comparable to those of the modern North Pacific before 2.5 Ma. The faunal composition of the deep and intermediate water species abruptly changed at 2.5 Ma, indicating that the formation of more oxygen-rich deep water initiated at that time in the sea. The reconstructed history of vertical water masses suggests exchanges of the deep water between the Japan Sea and the adjacent Pacific Ocean and, thus, deep channels are expected to have existed between them before the mid-Pliocene. Diversity of radiolarian assemblages was constantly lower than that of the North Pacific during the studied time interval.